



United States Patent

Application Number: 10/078,299

Filing/Receipt Date: 02/20/2002

First Named Applicant: Ying Liu

Name of Examiner: Rosario, Dennis

Name of Participants: Dennis Rosario (examiner), Ying Liu (applicant)

Confirmation No. 3371

Provisional Application Number 60/296,245

Provisional Filing Date 06/06/2001

Total Claims 28

Attrasoft Image Retrieval

Inventor: Ying Liu, Savannah, GA

Abstract	3
TECHNICAL FIELD	4
BACKGROUND OF THE INVENTION	5
TECHNICAL BACKGROUND	7
1. Images	7
2. Mapping	9
3. Markov Chain and Pattern Classification	9
4. Markov Chain and Neural Network.....	10
5. Artificial Neural Net	10
SUMMARY OF THE INVENTION	13
1. Process	13
2. Parameters.....	18
3. System Layout	20
4. Algorithms	21

5. Components and Application-Programming Interface	24
BRIEF DESCRIPTION OF VIEWS OF THE DRAWING	25
DETAILED DESCRIPTION OF THE DISCLOSED EMBODYMENT	27
Preferred Embodiment of the Search System	27
Overview of the ABM Algorithm.....	27
Overview of the APN Algorithm.....	29
User Interface Layer of software for implementation of ABM and APN Algorithms	32
Presentation Layer of software for implementation of ABM and APN Algorithms	37
ABM Layer of software for implementation of ABM and APN Algorithms.....	37
IVI-API (Image Verification and Identification Application Programming Interface).....	45
Enrollment.....	48
1:N Matching	48
N:N Matching	49
Parameters.....	49
Sample Implementation	51
Attrasoft ImageFinder 4.9.....	51
Attrasoft PolyApplet 5.0	53
Attrasoft TransApplet 5.1	54
CLAIMS	56
Appendix A. Accompanying Application Document and CD.....	59
Figure 1. Search Process, which is applicable to image verification, identification, and retrieval	65
Figure 2. 3-Layer Architecture for software implantation of the Present Invention.	66
Figure 3. Sample User Interface of the Present Invention.....	67
Figure 4. Sample Key Input for the Present Invention	68
Figure 5. Sample Search Output of the Present Invention. The search output is a list of pairs, or doublets.....	69
Figure 6. Sample Classification output of the Present Invention. The classification output is a list of triplets.....	70
Figure 7. Classification Process, which consists of multiple search processes in Figure 1..	72
Figure 8. Batch Process, which allows users to duplicate a Search or Classifications in two clicks.....	73
Figure 9. ABM and APN Algorithm Flow Chart.	74
Figure 10. An example of a fully connected artificial neural network with 4 neurons {3, 2, 1, 0}.....	75
Figure 11. The Markov chain generated by the neural net with 4 neurons in Figure 10....	76
Figure 12. More Detailed ABM Algorithm Flow Chart.....	77
Figure 13. More Detailed APN Algorithm Flow Chart.....	78
Figure 14. Connection Space and the Sensitivity distance.	80
Figure 15. Image Space and the Blurring distance.	81
Figure 16. ABM and APN Learning Algorithm Flow Chart.....	83
Figure 17. ABM Recognition Algorithm Flow Chart.....	84
Figure 18. APN Recognition Algorithm Flow Chart.....	85

Abstract

A system, methods, and algorithm for content-based image retrieval and recognition system, useful in all types images and image formats. An image(s) or an image segment(s), which is specified by the user in two clicks (the first in the upper-left corner and the second in the bottom-right corner), specifies the content-based sample. The sample image(s) is used to teach the system what to look for via the ABM (Attrasoft Boltzmann Machine) algorithm and APN (Attrasoft PolyNet) algorithm; the system then searches through one or many directories, which is specified by the user, and presents the search results. The search result consists of pairs matched image and a Weight (score), which specifies the similarity between the sample and matching images. These weights are also being used to classify images in the cases of the classification problem. The users are able to view the retrieved images in the result via a single click. When the algorithm is implemented as a software component, the system integration will follow the specification of the “Attrasoft Image Verification and Identification Application Programming Interface (IVI-API)”.